When composite panels are drilled or machined, the natural sealing process of lamination is disrupted. In areas where the fibers become exposed, an action can take place in which water, fuel, spilt liquids, etc. can be slowly absorbed through the fiber matrix interface into the structure. If the sandwich panels have an aluminum face sheet, the liquid can leak into the interior core of the panel. These leakage problems can result in weight gain, laminate degradation, and even unpleasant odors.

It is highly desirable that at most only a minimum portion of a fastener or spacer extend above the upper surface of a sandwich panel. One of the approaches in the prior art to address this issue has been to provide a rim in a spacer member that is mechanically locked by flaring the rim over the edge of the hole. Some installation of spacers in an aircraft floor sandwich panel have intentionally dimpled a metallic face skin where each spacer is to be inserted in order to insure a flush mounting. Another approach has been to provide a sleeve and plug composite spacer with a pair of flanges that overlap both sides of the hole. Any protrusions above the upper surface can be abraded and can further cause carpet wear. Adhesives can be applied to flanges to directly adhere a spacer member to the surface of a sandwich panel. In an attempt to seal an aperture in the spacer, ring seal washers have sometimes been used on fasteners in an attempt to sealingly compress them in the aperture. Additionally, a potting material of an appropriate epoxy can be used for further securing these types of spacers and fasteners.

The aerospace industry generally desires to automate the installation of spacers and fasteners to eliminate the high labor cost, wherever possible, particularly when hundreds and thousands of fasteners and spacers can be used in a commercial aircraft.

Thus, the prior art is still attempting to optimize the design of spacers and fasteners used in sandwich panels in aircraft and the problems of sealing with a flush installation of spacers with a surface of a panel has yet to be optimized.

OBJECTS AND SUMMARY OF THE INVENTION

The present invention provides an improved spacer and/or fastener that can be mounted within a panel, such as a composite or sandwich structure panel of a predetermined thickness with a drilled hole to provide a flush mounting of an upper edge of an upper rim member of the spacer with an upper face surface of the panel. A spacer can include a body member having a central aperture with a larger lower flange member that extends radially outward from the body member. The flange member will bear against the lower face surface of the sandwich structure panel. An adhesive can be applied between the lower flange member and the lower face surface of the panel to assist in securing the spacer to the panel. The upper rim member extends upward from the body member and is concentric with the central aperture. The rim member has a larger inner diameter, than the diameter of the central aperture, with an inner flange extending from the rim member to the central aperture. The spacer will be sized for a particular panel thickness, such that the upper edge of the upper rim member will initially be extended above the upper panel surface when the lower flange member is in contact with the lower panel surface by a predetermined distance.

A sealing compound or sealant, such as, but not limited to, a thermoplastic resin or a silicon resin, can be positioned annularly over the inner flange so that any fastener mounted within the central aperture can contact and deform the sealing compound to encourage a seal between the spacer and the fastener. Another outer ring or coating of

sealing compound can be positioned around the outer surface of the rim member to facilitate the sealing with the edge of the hole in the sandwich structure panel.

The resultant combination of the spacer sealed with the panel provides an improved panel assembly of particular advantage in wet area applications, such as a floor panel in a galley of an aircraft.

An alternative embodiment of the spacer can provide an upper rim member with an indented or annular recess relative to the outer diameter of the body member. A ledge or undercut is provided below a coating of sealant to thereby facilitate the carrying of the sealant through the sandwich structure panel so that it is positioned adjacent the upper edge of the hole or bore in the sandwich panel. Thus, when the rim member is contacted by a setting tool designed to provide a specific application of force for seating within and flush to the upper surface of the panel, the sealing compound will be distributed at the interface between the panel edge and the rim member to automatically effectuate a seal. Such a seal can not only render the joint liquid tight but can also address the galvanic corrosion problem. The inner diameter of the rim member can be undercut with an annular groove to bias the rim member to be deformed into the drilled hole.

Another embodiment of a spacer of the present invention can include a groove positioned about an outer diameter of the body member with the groove and surrounding surface of the body member coated annularly with the sealing compound. The groove helps to carry the sealing compound into the hole in the sandwich panel.

Finally, the flange can be provided with potting holes, if additional strength and support are necessary by applying an epoxy resin into the core of the sandwich panel.